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ASSESSMENT OF ENSILABILITY OF SIX TROPICAL GRASSES USING THREE DIFFERENT APPROACHES

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Abstract

The preparation of well-preserved silages is considered increasingly important in the tropics and subtropics. In these regions silage production played a minor role in the past, as ensilability of tropical grasses is generally considered poor. In this study ensilability of six tropical grasses grown in the Paraguayan Chaco Boreal (*Panicum maximum* cv. Gatton, *Cynodon plectostachyus*, *Cynodon sp.* cv. Tifton 85, *Digitaria eriantha* var. *pentzii*, *Panicum maximum* cv. Tanzania and *Digitaria milanjiana*) was assessed in three different ways: (1) The chemical determination of the ratio between water soluble carbohydrates (WSC) and buffer capacity (BC), (2) the biological rapid fermentation assay using additives of sucrose and/or lactic acid bacteria inoculants, and (3) modelling of silage preparation in plastic bags. BC and contents of WSC were low. Therefore, without additives, acceptable ensilability was attained only with two grasses when previously wilted, while four grasses were poorly ensilable. When soluble carbohydrates and lactic acid bacteria were added, ensilability was enhanced. The rapid fermentation test applied in this study represents an easy to handle tool to

asses ensilability of plants with different contents of fermentation substrates (WSC) and to investigate interactions between plants and a variety of epiphytic micro-organisms.

Keywords: Forage conservation, rapid fermentation test, silage additives, Chaco, Paraguay

Introduction

A more or less continuous fodder supply is indispensable for an efficient milk and meat production. The discontinuity of fresh forage availability due to seasonal rainfall variability is a major limiting factor of performance-oriented cattle husbandry in many tropical and subtropical countries. Therefore, conserving high quality surplus forages during the growing season by silage preparation is of particular importance in the (sub)tropics.

The objective of this study was to investigate the ensilability of six tropical grasses commonly grown in the Central Chaco Boreal of Paraguay. The grasses tested were Gatton (*Panicum maximum* cv. Gatton), Estrella (*Cynodon plectostachyus*), Tifton 85 (*Cynodon sp.* cv. Tifton 85), Pangola (*Digitaria eriantha* var. *pentzii*), Tanzania (*Panicum maximum* cv. Tanzania) and *Digitaria milanjiana.* It was expected to be able to detect causes of the poor ensilability, obviously inherent to tropical grasses, using a biological fermentation test. Furthermore practical recommendations were to be made, how to improve ensilability of grasses in farming systems.

Material and Methods

The experiments were carried out at the Central Chaco Research Station in Paraguay between October 1995 and March 1996. Samples of Gatton, Estrella, Pangola and Tifton 85 were taken in 10 days intervals, beginning with the growing period. Tanzania and *Digitaria milanjiana*, were only tested three times during the growth cycle.

To asses ensilability, three approaches were followed up: **I.** The ratio between water soluble carbohydrates and buffer-capacity (WSC/BC ratio; WEISSBACH, 1968), where carbohydrate concentration was determined colorimetrically and the buffer-capacity by lactic acid consumption to adjust the aqueous plant mixture to pH 4,0. **II.** A biological test (rapid fermentation test¸ PIEPER *et al*., 1989) with chopped plant material in aqueous suspension, with four treatments: (1) untreated control (without additives), (2) addition of sucrose (2%), (3) addition of LAB (lactic acid bacteria) inoculants, and (4) a combination of (2) and (3). The samples were incubated at 33-35 ºC for up to 46h. The rate and extent of acidification during the incubation time was measured. **III.** Additionally, silage preparation was modelled in plastic bags with the treatments ”fresh matter without additives”, ”wilted matter without additives”, ”fresh matter with LAB”, and ”wilted matter with LAB”, in order to cross-check the results obtained with the aforementioned methodologies. The bags were incubated for 30 days.

Results and Discussion

The WSC/BC ratios of the six grasses are shown in table 1. All grasses had low contents of sugars (WSC) and a normal buffer capacity. As a consequence, the WSC/BC ratio consistently remained below the critical value of 3.0, which refers to a poor ensilability (WEISSBACH, 1968). Among the grasses tested, Pangola produced the highest but still inadequate WSC/BC ratio of 2.0.

The results of the rapid fermentation test are shown in the second part of table 1. Rapidity of acidification is very important in silage-making. In order to inhibit the growth of undesirable micro-organisms, pH ought to be lowered to 3.6 during an incubation time of 22 hours. None of the grasses tested reached this value without additives. The addition of lactic acid bacteria (LAB) had a positive but still unsatisfactory effect on pH-reduction. Obviously,

water soluble carbohydrate concentrations (fermentation substrates for LAB) in the grasses were too low to support an acceptable rate and extent of acidification. The sole addition of sucrose was essentially more effective than the sole LAB addition though still inadequate, indicating an insufficient stock of native epiphytic lactic acid producing bacteria on the grasses. However, the combined LAB and sugar addition generally brought about a fast and effective drop of pH in most grasses. The exceptions refer to Tanzania and D*igitaria milanjiana.* This can be attributed to the high buffer capacity detected in these materials.

Table 2 shows the data obtained from the materials ensiled in plastic bags. The silage models were considered stable when the DM-dependent critical pH-value was reached, as defined by WEISSBACH *et al*. (1974). The results confirm the poor ensilability of the grasses tested and are in agreement with the chemical (WSC/BC) and the biological (rapid fermentation) assays outlined earlier. No consistent trend was observed when DM content was raised by wilting previous to silage preparation. When LAB inoculants were added biological stable silages could be produced with Pangola.

It is concluded that the tropical grasses tested in this study are generally poorly ensilable due to their low sugar contents (WSC). Previous wilting as a sole treatment failed to enhance ensilability as the pH required for silage stability was not attained. However, when grasses were wilted and lactic acid bacteria (LAB) added, adequate silage characteristics could be produced with Pangola and Estrella. The combination of the additives LAB and sucrose facilitates the production of well-preserved silages from tropical grasses. In Paraguay, the use of molasses, an inexpensive by-product of the sugar industry, is recommended as an additive for improved farm scale silage preparation.

A very good consistency is observed between the results of the three approaches applied for ensilability assessment: Ratio between water soluble carbohydrates and buffer capacity, rapid fermentation test, and silage modelling in plastic bags.

References

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Table 1 - Ensilability of six tropical grasses as determined by two different methods

Grasses	Gatton (13)	Estrella (10)	Pangola (8)	Tifton 85 (9)	Tanzania (3)	*D. milanjiana* (3)
1. WSC/BC ratio						
WSC [g/kg DM]	34±18	34±10	46±17	19±6	27±9	36±12
BC [g LA/kg DM]	32±5	35±5	25±4	21±3	66±4	40±3
WSC/BC ratio	1.1	1.0	2.0	0.9	0.4	1.0
2. rapid fermentation test - pH-value after 22 hours						
Untreated control	4.9±0.3	4.2±0.1	4.5±0.5	4.9±0.4	5.4±0.1	4.7±0.3
LAB	4.3±0.3	4.0±0.2	4.0±0.2	4.7±0.4	5.1±0.3	4.5±0.1
Sucrose	4.2±0.3	3.9±0.1	3.9±0.2	3.8±0.1	4.8±0.5	4.3±0.3
LAB + sucrose	3.6±0.1	3.6±0.04	3.4±0.1	3.6±0.1	4.2±0.5	3.8±0.3

WSC - water soluble carbohydrates
BC - buffer capacity
LA - lactic acid
LAB - lactic acid bacteria
() number of samples

Table 2 - Influence of dry matter content and addition of LAB on anaerobic stability of silages as modelled by silage prepared in plastic bags

DM [g/kg FM]	Number of silages prepared	Number of stable silages	
		without LAB-inoculant	with LAB-inoculant
<200	7	0	0
200-300	18	0	2
300-400	21	0	6
400-500	6	0	5
>500	4	0	2
Total	56	0	15